



# Implementing a Paperless Environment

## The NAVSTAR GPS Block IIF Engineering Management System Project

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*This article describes the rationale and award-winning benefits of a computer-aided acquisition lifecycle support system. The system has produced savings in cost and efficiency, all while boosting oversight capabilities. The robust information systems infrastructure for the NAVSTAR GPS Joint Program Office allows lifecycle logistics support and separates applications from data, thus protecting major investments in databases. The system has allowed a reengineering of business processes by integrating work-flow and document management. The system also establishes an open architecture for future application and process integration through the extensive use of government and industry standards.*

The Navigation Satellite Tracking and Receiving (NAVSTAR) Global Positioning System (GPS) Joint Program Office (JPO) is a joint-service, multinational organization with over 375 employees. The office develops, acquires, and sustains a 24-satellite constellation, a worldwide satellite control network, over 80,000 receiver systems, and a nuclear detonation detection system. The system is a priority Department of Defense (DoD) force enhancement program that provides the capability to precisely determine position, velocity, and time and to pinpoint nuclear events.

The JPO is located at four primary sites: Los Angeles AFB, Calif.; Peterson AFB, Colo.; Robins AFB, Ga.; and Patrick AFB, Fla.

In mid-1992, the GPS JPO was faced with a major problem. At that time, the 375 users comprising the program office used numerous PC-based applications to accomplish various tasks. Printers were shared through serial data switch boxes. Computer support consisted of several people traversing the building all day in a futile attempt to "standardize" the software on users' systems and keep the various printers and printer interfaces operational. Systems support was becoming exceedingly difficult and was spiraling hopelessly out of control.

End users would access myriad various mainframe applications to accomplish their job functions. Several proprietary systems hosted on proprietary hardware and operating systems were in place (IBMs VAXs, WANGs, HP 3000s, etc.). Each system and application was its own "island of information." Subsequently, even though there was a physical network in place, there was no communication between systems. Users could not send data from one system to other systems or other users. They had to continue to use paper.

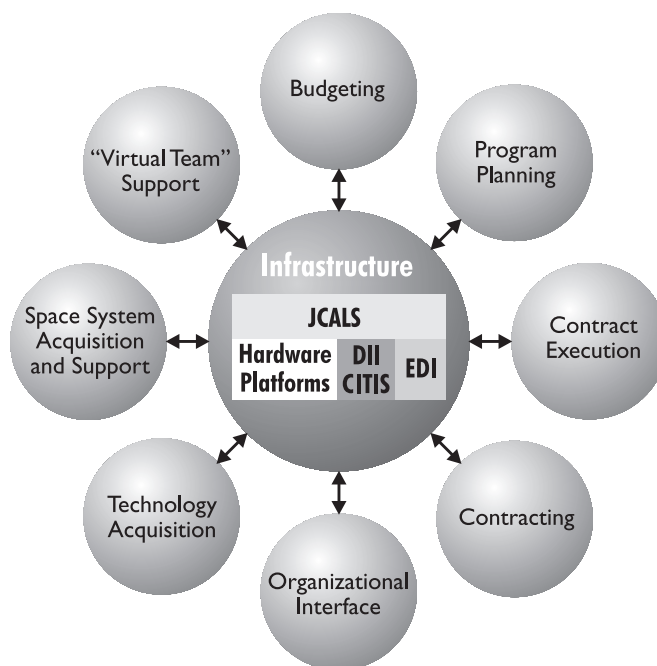
At the same time, the program office continued to generate thousands of pages of paper-based documents and information daily. Air Force leadership was pressing for all program offices to implement acquisition reform initiatives. The program

office's leadership was pressing for the introduction of cross-functional integrated product teams (IPTs). This created the need for information sharing among geographically dispersed individuals, the need to open new lines of communication, and the requirement for greater and faster access to all program data.

### GPS Engineering Management System

Acquisition reform is a new philosophy for weapons systems procurement that emphasizes government "insight" into contractor processes rather than oversight. The GPS Engineering Management System (GEMS) is a distributed enterprise information infrastructure that is being developed by the NAVSTAR GPS JPO to support Integrated Weapons Systems

Figure 1. Business processes overlaid upon the GEMS infrastructure.



Management (IWSM) and acquisition reform initiatives within the JPO. IWSM is an all-encompassing, cradle-to-grave weapons systems management concept. GEMS:

- Allows the integration of JPO business processes with the system development processes of its contractors by taking advantage of the latest advances in information technology.
- Enables the creation of several paperless processes in an integrated GPS program-wide environment, including a cost and schedule management process, a document review process, data call processes, and an engineering change proposal process.
- Separates applications from data, protects major investments in JPO databases, and facilitates business process reengineering by integrating workflow and document management.
- Is an innovative approach to JPO business process automation that combines the DoD Joint Continuous Acquisition and Lifecycle Support (JCALS) system, best-of-breed industry standard commercial-off-the-shelf (COTS) software and hardware, and electronic delivery and access to all unclassified program data to the JPO.

Electronic delivery of data to the JPO is accomplished by the implementation of a Contractor Integrated Technical Information Service (CITIS) for all prime contractors that participate in GPS JPO programs. CITIS is an electronic link between the JPO's GEMS and the information systems used by GPS contractors. CITIS also includes the use of standard data formats, the GEMS shared data service client software, GEMS workstation client software, and other mutually agreed to COTS software tools.

Program data developed by GPS contractors is made available or delivered to the JPO via the electronic link. Documents delivered to the JPO are placed into a shared electronic library that maintains version control, access control, and status of the data. After the data is delivered to the JPO, JPO IPT members start the coordination of the documents

electronically by routing program data through the JPO via the JCALS workflow manager.

## Objectives

The objectives of the GEMS project are to redesign the GPS JPO's information systems infrastructure to directly support the concepts of IWSM, integrated product development, concurrent engineering, acquisition reform, integrated weapons systems management, and the seamless integration of JPO business processes that can span across the program office and its contractors.

The GPS Block IIF Program, responsible for the procurement of the next generation of GPS satellites, foresaw the critical need for GEMS, and fully supported GEMS objectives.

Lt. Col. Al Moseley, the GPS Block IIF program manager, stated, "The Block IIF program would be the first integrated product team in GPS, and one of the first in the Air Force and the DoD, to implement a paperless system to meet program and acquisition reform objectives."

## Implementation for GPS Block IIF

The GEMS infrastructure was implemented in a modular fashion, one process at a time, and rolled out incrementally to each IPT within GPS. Over the past year, GEMS has expanded from a pilot process to receive and review Engineering Change Proposals electronically to one that now allows users to perform all configuration and data management on-line and integrate the cost and schedule management process (see Figure 1).

The GEMS configuration and data management tools integrate and automate the JPO data management process. The data management tools give JPO users the ability to generate AF (Air Force) Form 585 and AF Form 1423, conduct data calls, conduct data scrubs and track all Contract Data Requirement Lists (CDRLs) under review. The tools also make it easier to board documents at the JPO configuration control board and report on data metrics by extracting the required data from the GEMS database.

Acquisition reform calls for a reduction of the number of CDRLs for a program. One of the management principles of the GPS Block IIF Program is electronic access to all unclassified program data. The GEMS data management tools, originally used to determine which CDRLs were to be placed on contract, now help the JPO determine what program data contractors are required to make available electronically via GEMS and CITIS. The use of GEMS allowed the GPS Block IIF Program to reduce the number of CDRLs placed on contract from 339 to three (see Figure 2).

## Benefits

GEMS allows the GPS Block IIF and related programs to immediately begin doing things better, faster, and cheaper. In terms of the quality of JPO business processes, measurable improvements have been noted in the following areas.

**Shortening the process cycle.** Prior to GEMS, the processing cycle for authentication of a system specification was 18 to 24 months; the new authentication process is now six months. The reasons for most delays can be immediately detected via the work-flow and corrective action can be taken.

**Standardizing JPO processes.** The paper-based processes varied greatly; now, most JPO processes are documented not only in operating instructions but also in GEMS work-flow templates. The work-flow templates show the proper routing of documents and tasks to the proper offices for each type of process. When action is required on an electronically delivered document, an individual in the office of primary responsibility can select the appropriate work-flow process template for a given function, make any necessary adjustments, start a "job," and accurately track the status of the document.

**Empowered team orientation.** The reengineered GPS Block IIF IPT business processes use GEMS. This results in a largely matrixed organization, grouped by IPTs, in which each team is responsible for a product and given sufficient decision-making authority. In the old system, documents were being circulated

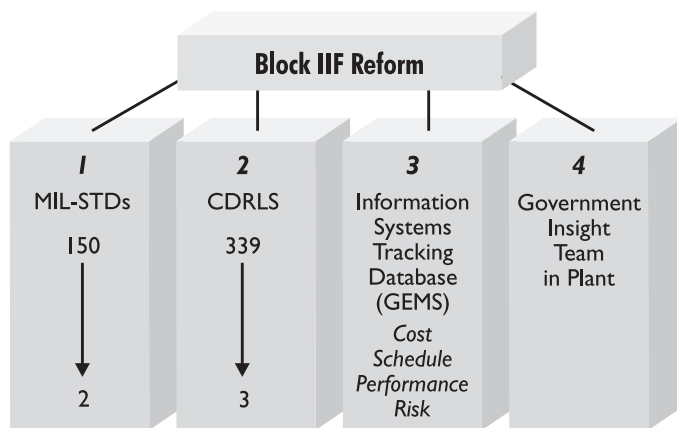


Figure 2. GEMS impact on GPS Block IIF Program.

among functional departments. Documents are now handled by cross-functional project teams, and the JPO business processes are well defined and easier to manage.

**Facilitation of “process change.”** GEMS has allowed the creation of “virtual teams” that consist of both contractor and Block IIF IPT members working side by side in the contractor’s plant and in multiple locations. Users quickly communicate issues throughout the group via the infrastructure. The organizational culture has become much more receptive to change, and information technology provides the necessary channels to disseminate information and facilitate change.

**Stable configuration management.** The heart of the GEMS system is the reference library, which holds most of the GPS program data. This data is cataloged by several factors (project, organization, type, subtype, date, etc.) for easy search and retrieval. The reference library is the single location for current copies of all program data; this eliminates having multiple versions of documents in circulation. Authorized individuals have fast access to the latest version of a document, including updates, from one location. The data is archived for safe, long-term storage.

**Flexible implementation and usage.** The nature of GPS JPO business forces GPS Block IIF team members to conduct business in many places other than their offices. The wide-area network and CITIS will permit users to view the same data from an equipped contractor’s facility or remote JPO location. Based on their account privileges, these users have the same capabilities they have in their home office. Because of these capabilities, collocated GPS Block IIF team members in the contractor’s plant are achieving unprecedented partnerships.

**Management “insight” vs. oversight.** The flexibility of GEMS permits GPS Block IIF IPT leads to task any GEMS user no matter where they are located. GEMS users will always have all the necessary tools and data to accomplish the work, even when they are not in the home office. The GPS Block IIF IPT leads have the same insight into job progress as if they were right down the hall.

## Authenticating a GPS Block IIF Specification

Authenticating a specification is the process of reviewing the specification for accuracy and completeness by the government and contractor’s engineering teams. An example of how GEMS is streamlining GPS operations is the authentication of the GPS Block IIF System Specification for the new GPS Block IIF satellite. This document serves as the technical backbone of the GPS Block IIF program and is the starting point for thousands of derived requirements.

Before GEMS, this process had always been long and costly. Paper copies of the specification were distributed and passed from one engineer to the next. The engineers had the continual task of coordinating comments, scheduling meetings, and checking status. Different groups of engineers would review issues that others had already resolved. Just the cost to reproduce the document would run into the thousands of dollars before a draft would be approved.

Because of the inability to track and manage the review process, the paper-based method of authenticating system specifications would normally take one to two years after contract award. Now, using GEMS, the reengineered process is significantly streamlined. Distribution to the entire GPS engineering team is virtually instantaneous. The reviewers can simultaneously see all comments to the document as soon as they are entered. Work-flows allow for management and tracking of the document throughout the review cycle. Key reviewers are notified if their input was overdue, thus helping the authentication review run smoothly.

Review managers no longer need to sit down with stacks of the same document with everyone’s comments in the margins and try to consolidate them. Managers are now able to review, consolidate, approve, and transmit the results back to the contractor for incorporation.

The streamlined process using GEMS allowed the GPS Block IIF IPT to authenticate the IIF system specification in six months after contract award. The time savings not only saved substantial money but also has given both the government and contractors a solid baseline to build the GPS Block IIF program much sooner than would have been possible with the paper-based process. This in turn will help prevent requirements creep, which may save the government even more money in the future by preventing cost overruns.

## Lessons Learned

- A key factor in the success of the GEMS project has been senior management commitment, a well-known success factor for any program that requires cultural change.
- User involvement in the early stages of the project helped ensure acceptance of the system.
- Variations in the desktop computer environment should be eliminated to the fullest extent possible. This will accelerate rollout and training and greatly reduce the burden on the system help desk.
- After the design and development of the new systems and processes are completed, management should resist the

desire to roll out the new systems too quickly for instant payback. A well-managed rollout to individual functional groups will allow for better and more targeted training and will contribute to a smoother implementation.

- Implementing electronic access to program data creates several issues related to the "ownership" of program data and who maintains the data of record. For the GPS Block IIF Program, this was resolved by the concept of a shared data environment between the contractor and the program office databases. Data in each database can be viewed by both government and contractor IPT members. Data to be retained by the program office can easily be transferred from the contractor's database to the GEMS reference library by IPT members over the electronic link.
- Credit should also be given to the implementation method. System development and deployment should not be implemented piecemeal during the process reengineering effort (risky integration), or a monolithic, all-at-once approach (too long to see results), but instead implemented in a modular, layered, bottom-up ap-

proach to minimize risk exposure and maximize flexibility.

### Summary

The GEMS-based enterprise infrastructure fills the gap between ordinary office automation and the automation of JPO business processes. Using the DoD's JCALS infrastructure has allowed the IPTs of the NAVSTAR GPS JPO to concentrate on deploying modular process-based applications that can share enterprise data. Unlike systems that do not take advantage of continuous acquisition and lifecycle support (CALs) and industry standards, there are no constraints on data reuse, the longevity of data, or the amount or types of data (records, documents, or graphics) the system can manage, route, and warehouse. The organization retains its investment in applications, business processes, and data.

Because the GEMS business process applications that are developed on the DoD's JCALS infrastructure are modular and use CALs and industry standard data formats, the applications and process work-flows can be easily updated as the GPS JPO continuously improves its business processes. The applications can also be customized and deployed to other system program offices that use the JCALS infrastructure. GEMS has al-

lowed the GPS Block IIF program and the GPS JPO to immediately implement acquisition reform initiatives by permitting fast, timely access to all unclassified program data.

Because of initiatives such as GEMS, the GPS Block IIF program won the 1995 Defense Standardization Program Award and the Secretary of the Air Force for Acquisition's Lightning Bolt Acquisition Reform Award for leading the way in acquisition reform excellence. The GPS JPO and the GPS Block IIF team continues to challenge themselves to do business better. ♦

### About the Author



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has a bachelor's degree in economics/computer science and in sociology from the University of California at Los Angeles and a master's of business administration degree from Pepperdine University.

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### Web Addition

The following is excerpted from Emmett Paige's keynote address at the Tri-Ada conference in St. Louis in November 1997. The speech can be found in its entirety in *CROSSTALK's* Web Addition section at <http://www.stsc.hill.af.mil/CrossTalk/crostalk.html>.

## The New Course for Ada in the DoD

**Retired Lt. Gen. Emmett Paige Jr. (U.S. Army)  
President, OAO Corporation**

*"There are numerous examples of superior technology failing to capture a consumer market. Military software has different requirements than consumer software. The DoD needs to learn what it can from the commercial sector and use those best practices that are applicable and appropriate for military requirements.*

*"The National Research Council study is right in asserting that Ada needs government support to survive. The Ada effort also needs help from industry to aggressively produce and market high-quality Ada tools and compilers. Perhaps most important is support from the education community. Without more and more well-educated scientists and engineers, not only will the Ada effort fail, but American technological superiority will become history."*